IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 5, May 2022
Impact Factor: 6.252

Design and Analysis of Bicycle Chassis Frame

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Abstract: *Human beings are currently unable to devote specific attention to their health. This emphasizes the significance of exercise and physical fitness. In this paper, we look for another alternate source, such as an electric vehicle, to help with the time crunch and pollution control. Because electric vehicles are light, they may be utilized anywhere. The final goal of this paper is to develop and assess a chassis frame. In this paper we are also attempting to comprehend several forms of chassis frames in order to assess deformation and material selection. Cycles can now be regarded a good mode of transportation for neighbouring destinations due to rising fuel prices. In smart city people have very hectic schedule to deal with it they always refer a fastest route for transportation so that they can save their time and utilize it elsewhere. So electric cycle can be the best solution for them, it can be the fastest and cheapest route for transportation. As these electro cycles are light in weight, they can be easily carried out on shoulders without feeling of uneasiness. This cycle is ideal for use of short distance and for the people of any class and age.*

Keywords: Electric bicycle, chassis frame, electric vehicle, CAD design, Static Structural analysis

I. INTRODUCTION

In the current environment, there is an increase in mobility, which means there will be an increase in vehicle circulation. Internal combustion is currently on the rise, and it is the leading cause of air pollution. As a result, electric vehicles are the most environmentally friendly and convenient mode of transportation. Again, these automobiles are affordable to people of all economic classes. The chassis is an important component of an electric vehicle since it serves as the base for the body and other components. The goal of the project is to construct modelling and simulation for an electric chassis frame in order to calculate and analyse the data. CATIA V5 was used to design the vehicle chassis, while ANSYS was used to do the analysis.

II. PROBLEM STATEMENT

In today World the requirement of energy resources and its consumption is rising rapidly. Therefore, the need for Electric Bicycle is high. For a good bicycle it's foundation that is the chassis should be well designed and built considering all the dimensions. If the chassis is constructed properly using the best material, the performance of vehicle can greatly be enhanced.

2.1 Objective

The paper contains the given objectives.

1. Which material should be selected for the chassis
2. To build a chassis which will be suitable for an Electric Vehicle.
3. Calculating the maximum stress and comparing it with different Materials.

2.2 Future Scope

1. Electric vehicles are widely used as a daily commuter in various countries
2. Many countries abroad and their citizens have adapted towards it and are following it tremendously. A great alternative for Petrol/Diesel vehicles an electric cycle/vehicle plays a vital role. If we look towards healthy living a fit lifestyle electric cycle can play major role. Conservation of energy resources as well as pollution control is possible if electric vehicle /cycle comes in daily use.
3. Making a lighter chassis and a durable one makes it more efficient.

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III. METHODOLOGY

Step 1: Studying of Papers
This is the first step and it involved studying of different research papers and gathering information. It collects all relevant data and assemble it for evaluation and summarizing. The main sources of information are current market and trends. Complete, accurate data allows designers in identifying, finalizing the specifications required of the end product

Step 2: Deciding of geometry and material
The frame is designed such that it forms a suitcase like compact structure with sufficient strength when folded. For this we design a pivot joint which connects the rear wheels with the frame.

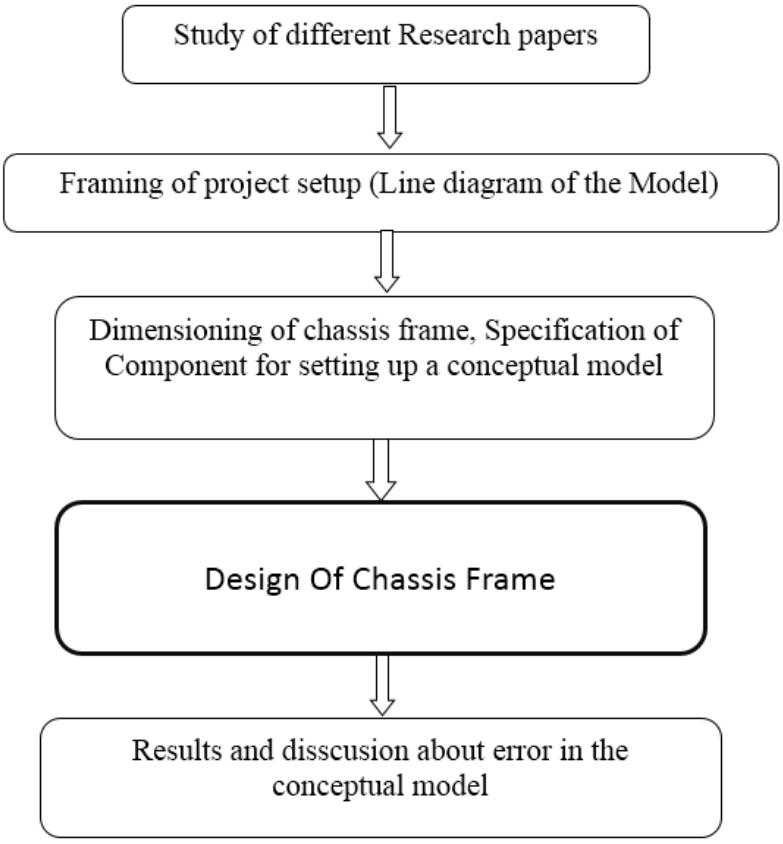
Step 3: Dimensioning Of frame and its overall structure
Different types of chassis structure were examined for the design of the chassis and also to get an overall estimate.

Step 4: Making of CAD model of the Bicycle
Using the above collected and calculated data, a CAD model is prepared of the proposed Bicycle.

Step 5: Structural analysis of the CAD model
The final CAD model of the Bicycle is structurally analysed using ANSYS for failure of parts.

3.2 FLOW CHART

Methodology of Working Process:



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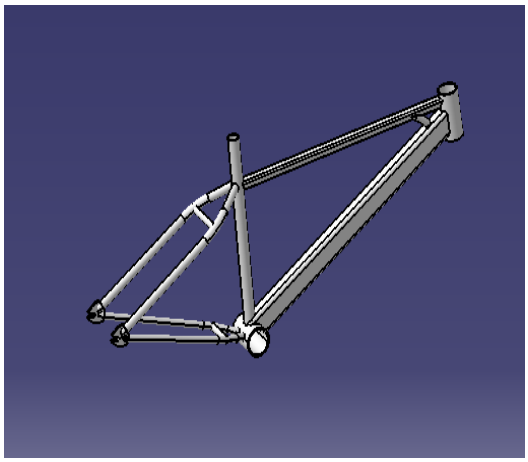
IV. System Design and Component

In our attempt to design we have adopted a careful approach, the total design work.

4.1 Mechanical Design

Mechanical design mainly concerns the very physical conditions and ergonomics, requirements of space, various arrangement of component and other design considerations. We started to design with DX CATIA. So, for analysing and comparing we designed a chassis having a rectangular tube at the bottom. Various designs were considered but the simpler design approach was considered and we decided to analyse this design with two different types of materials for the rectangular tube design. The Materials we decided to use were Stainless Steel and Aluminium, various parameters for design chassis were considered in this process.



Rectangular Chassis Frame

Materials like Stainless Steel and Aluminium were considered based on their availability and also their cost, they were easily available and also easy in case these design needs to be manufactured. Considering these two materials the analysis was done in the Ansys Workbench.

For Simulation Ansys Workbench is used the chassis structure was imported into ANSYS for further verification, and testing the actual capacity of the chassis various loads were applied to the chassis.

Constraints were given and the chassis was constrained. Later on loads were applied the 1000N was applied at the seat position and the 1100 N was applied at 100 N, the seat load was altered also to be at 1000N and 100N and the results were calculated by applying them to different materials as well.

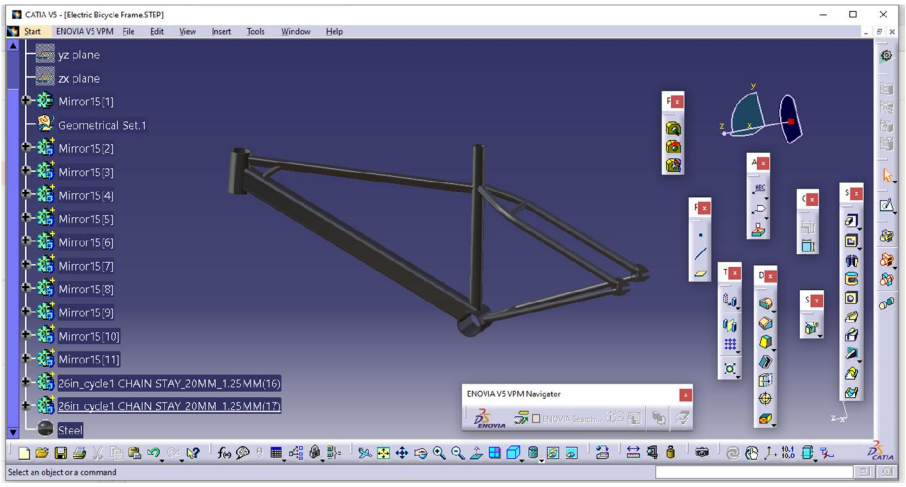


Fig. (1) Aluminium Chassis Frame

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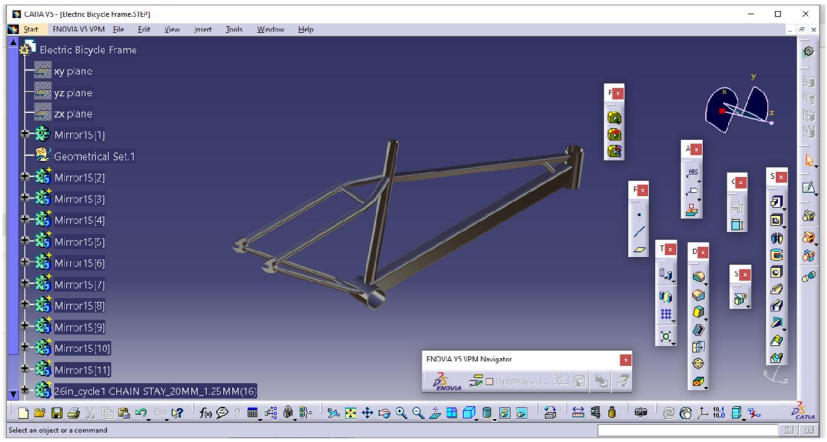

Fig. (2) Steel Chassis Frame

4.2 Material Selection

The selection of the material in design depends on various factors such as load, function, climatic condition, lifetime, and overall expenditure. Taking the above factors into consideration, material selection was done in order to design an efficient and economical type of frame. Steel Alloys, Aluminum and its alloys, Titanium, Carbon Fiber were preferred type of materials during selection. Comparatively, AISI 4130 Alloy Steel [2] was used in the present study as it is easily available, cost effective, and has improved mechanical properties.

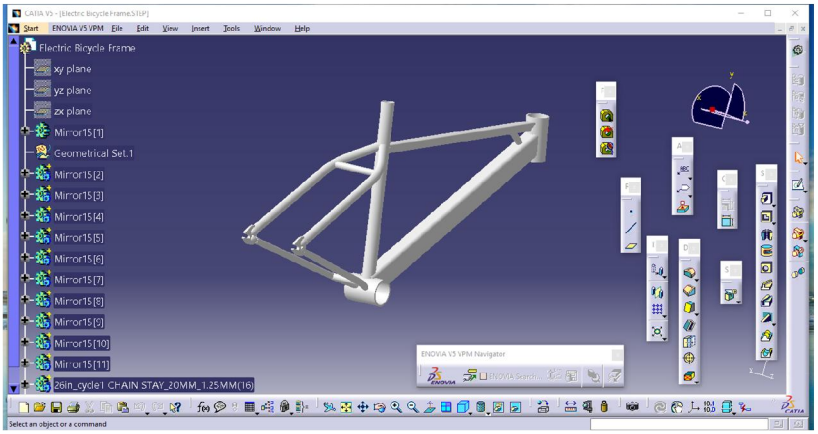

Fig. (3)

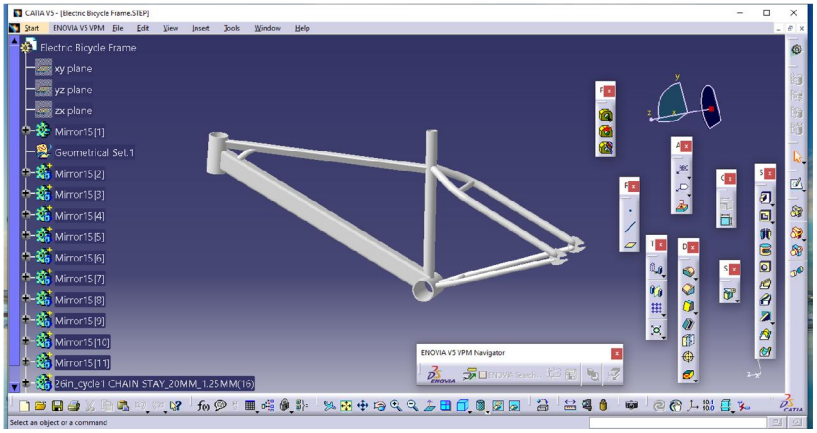

Fig. (4)

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4.3 Results

The Simulation was carried as mentioned in the above and the loads were applied to seat and pedal areas of the chassis the results were obtained and were analysed and the following are the pictures.

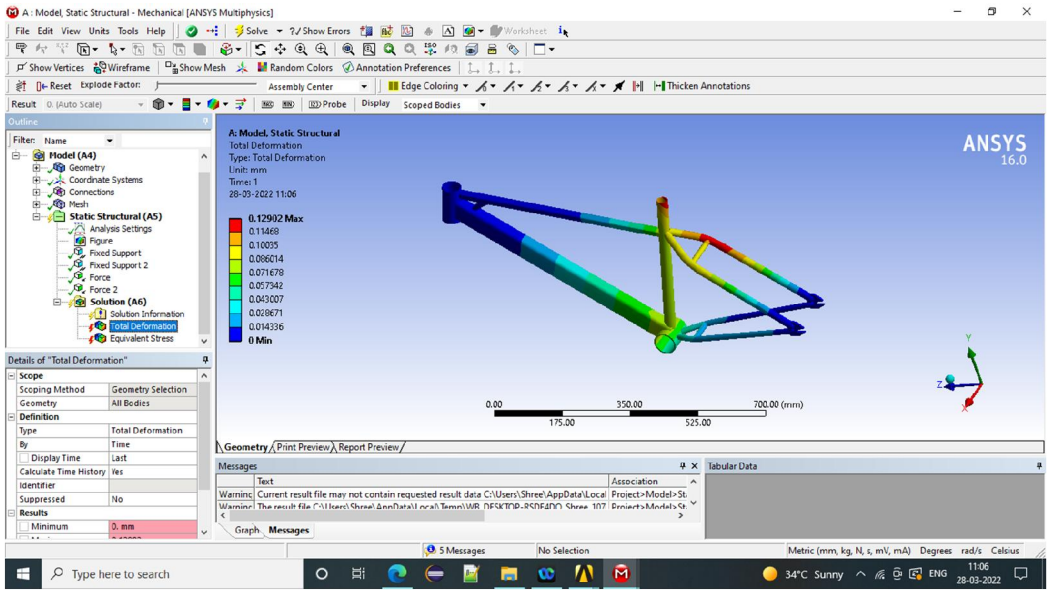

Fig. (5)

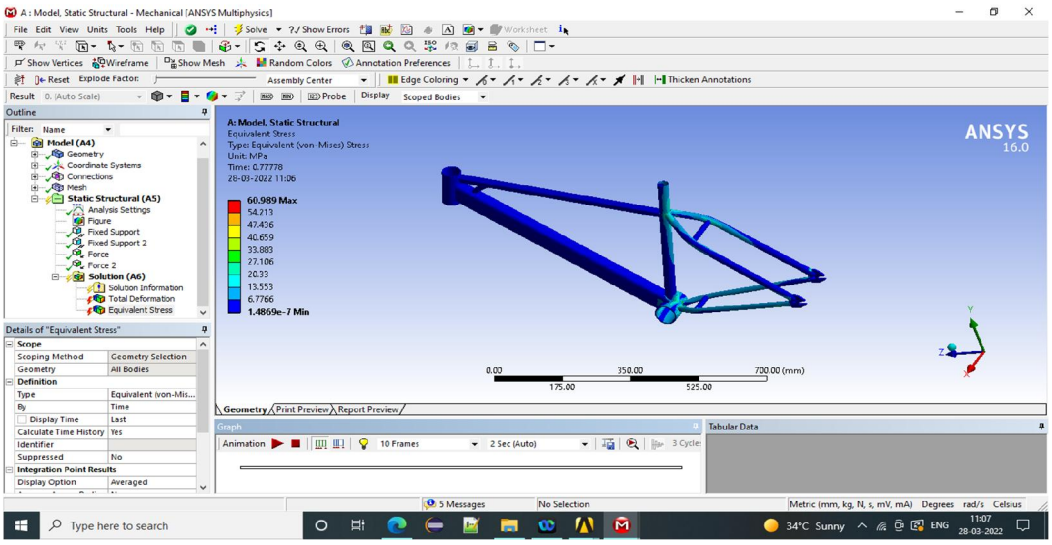

Fig. (6)

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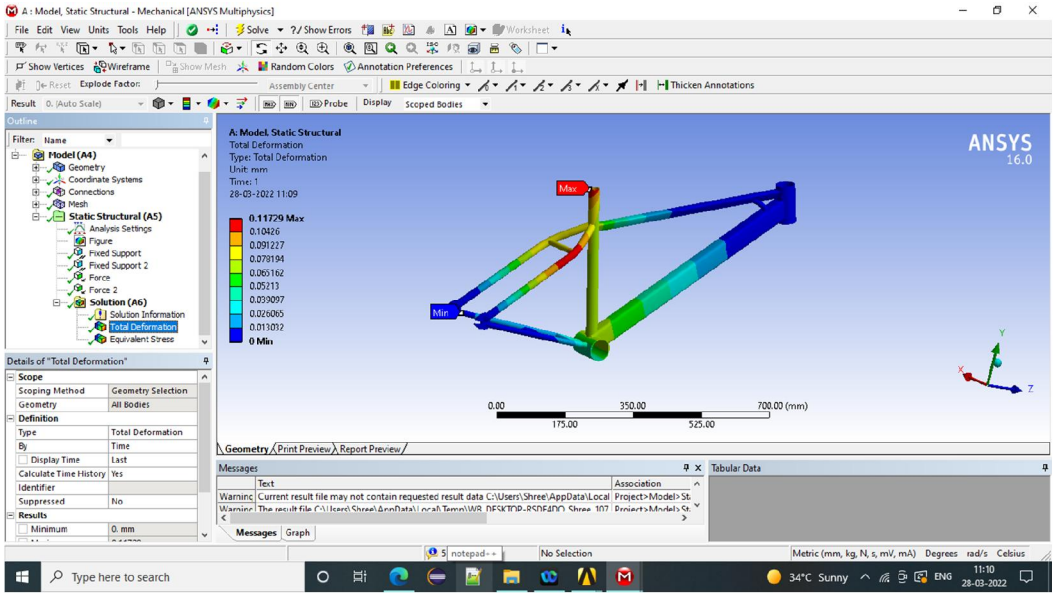

Fig. (7)

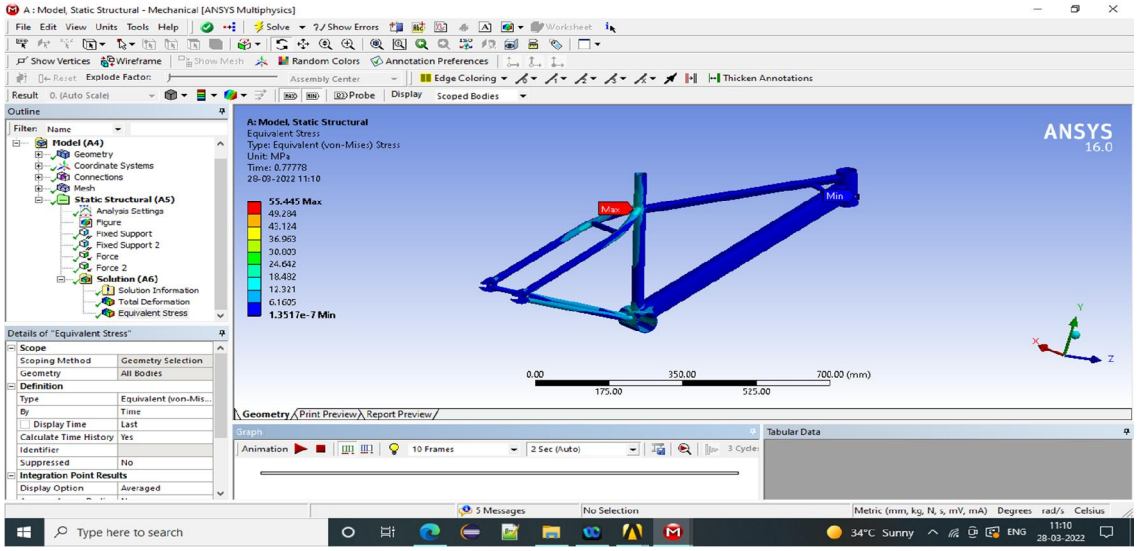

Fig. (8)

Here we can see that in every material and different load the main point at which the load is concentrated at the top position but that was not a concern as the overall factor of safety factor was appropriate.

V. CONCLUSION

1) Overall weight of chassis 1. Aluminium 1.5 Kg
2. Stainless steel 4.5kg

2) As we can see here that the weight of aluminium extremely less but it still does satisfy our conditions, but for safety conditions, aluminium can be very much weight effective but stainless steel's weight is very much low compared to other frames that we took reference from.

3) From the above analysis result the deformation is located at the top of rod mean at the position of seat as well as at the joints where tires are fitted.

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4) In this proper design of the chassis was designed to obtain all deformation conditions and to check rigidity.
5) As well as analysis of frame was done with 2 different materials which are aluminium alloy and structural steel respectively.
6) From the ANSYS result it was clear tensile yield strength of aluminium is greater than steel.

ACKNOWLEDGEMENT

We would like to thank our project guide Prof. S. M. Dhaneshwar for her valuable guidance, and also for all the necessary faculties which were needed for our completion of project and also, we would like to thank Dr. R. R. Arakerimath (HOD Mechanical Engineering Department). Our college has also provided all the faculties that we needed for completion of our project

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